

MONTHLY WEATHER REVIEW,

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(General Weather Service of the United States.)

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In preparing this REVIEW the following data, received up to February 14th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 136 Signal Service stations and 16 Canadian stations, as telegraphed to this office; 157 monthly journals and 150 monthly means from the former, and 12 monthly means from the latter; reports from 27 Sunset stations; 234 monthly registers from Voluntary Observers; 43 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from Voluntary Observers in, and the local Weather Service of, Missouri; reliable newspaper extracts; special reports.

BAROMETRIC PRESSURE.

The general distribution of atmospheric pressure for the month, as reduced to sea-level, is shown by the isobaric lines upon Chart No. II. When compared with the January averages for the past eight years, the distribution of pressure for the present January is found to be very abnormal. From Lake Ontario to Virginia and thence northeastward to Maine it has been in excess, gradually increasing northeastwards to 0.13 inch on the east coast of New England; it is also slightly in excess (0.04) at Santa Fe and San Francisco. At all other stations there has been a deficiency; it averages about 0.04 on the South Atlantic coast and Lake Erie; 0.08 along the Gulf coast; 0.11 from Arkansas to the Lower Ohio valley and lakes Michigan and Superior, and in the Lower Missouri and Upper Mississippi valleys, 0.18; the largest deficiency, 0.21, occurs at La Crosse. At Virginia City, Montana, the deficiency is 0.13 and at Portland, Oregon, 0.11.

Local Barometric Ranges.—The total range of the reduced barometric readings have averaged about as follows: New England, 1.14 inch at Wood's Holl to 1.38 inch at Burlington; Middle States, 1.21 inch at New York to 0.93 inch at Norfolk; South Atlantic and Gulf States, 0.80 inch at Wilmington, 0.54 inch at Key West, 0.63 inch at New Orleans, 0.69 inch at Indianola, 0.97 inch at Shreveport; Mississippi and Ohio valleys and Lake region, from 0.99 inch at Memphis to 1.11 inch at Pittsburgh, 1.39 inch at Alpena and 1.33 inch at Duluth; Eastern Slope, 1.42 inch at Bismarck and 1.33 inch at Dodge City; Rocky Mountain Stations, 0.67 inch at Santa Fé to 1.19 inch at Virginia City; Plateau Districts, 1.00 inch at Salt Lake and Winnemucca, and 1.28 inch at Boise City; California, 0.61 inch at Los Angeles to 0.92 inch at Red Bluff.

Areas of High Barometer.—Thirteen high areas have appeared within the limits of the United States during the month. Nine of them appeared to develop over the extreme Northwest or Manitoba; one over the Mississippi valley, while the other three first appeared upon the Pacific coast. The latter are specially interesting on account of the low temperatures accompanying them.

This Paper is furnished by the Government of the United States, without charge to the Co-operating Observers acting with the Signal Office in the collection of Simultaneous Reports.

No. I is a continuation of high area No. XI of the *December Review*; at 7 a. m. (Washington mean time,) it was central over the Upper Ohio valley, while the pressure was above the normal from the Southwest to Lake Michigan and thence to the Atlantic coast; north to east winds prevailed, with light rains in Texas, and foggy weather thence to Missouri and North Carolina; northwards, clear, frosty weather, followed by rising temperature during the day, and at night in the Ohio valley, light rains, as low area No. II progressed eastward over Canada. On the 2nd the barometer continued above the normal over the Southern States, with clear weather; while easterly to southerly winds and light rain continued from Texas to the Ohio valley.

No. II followed in rear of low area No. II. At 11 p. m. of the 1st the pressure had reached the normal in Dakota, and by 7 a. m. of the 2nd the highest pressures were over Minnesota; during the day the pressure increased as the area moved eastward over the Lake region and Canada, while it fell rapidly over the Northwest in advance of low area No. III. 3rd, moved eastward and at 11 p. m. was central over Nova Scotia; during the day the pressure increased over the South Atlantic States. 4th, the pressure over Canadian Maritime Provinces fell rapidly in advance of the low area before referred to, and the maximum pressure was transferred to the South Atlantic coast; clear or fair weather in the Southern States, but continued rains from the Southwest to the Lower Lakes in the barometric trough left by low area No. III, and which separated the present high area from the following.

No. III appeared over the Northwest during the night of the 3rd accompanied by clear, cool weather; on the 4th, moved rapidly eastward in rear of low area No. III to the lake region, and on the 5th thence to New England and Lower Canada. On the 6th it moved southeastward over Nova Scotia and Cape Breton; on the morning of which day the thermometer at Sydney, C. B., fell to -6° .

No. IV appeared over the Northwest during the night of the 5th and on the 6th and 7th moved rapidly eastward over Canada and New England to the Gulf of St. Lawrence, where the pressure remained high until the 9th, on the night of which day it fell rapidly in advance of low area No. V.

No. V appeared over the Northwest during the 9th in rear of low No. V and at 11 p. m. was central in the Mississippi valley. 10th moved northeastward with increasing pressure and on the 11th was over Nova Scotia.

No. VI appeared on the Pacific coast on the 10th in rear of low area No. VI. 11th, extended eastward over the Plateau Districts, producing the minimum temperature of the month (27°) at Visalia, Cal. 12th, at 7 a. m. the highest pressure was at Salt Lake City, (0.34 in. above the normal,) with minimum temperature of the month (2°) at that station. 13th, moved to the Eastern slope and merged with high area No. VII. On this day the minimum temperature of the month occurred at Fort Gibson, 26° and Henrietta, 27° . Cautionary Signals for a "norther" ordered at Indianola and Galveston, were justified at former station by a north wind of 35 miles.

No. VII appeared over the Northwest during the 11th, in rear of low No. VI, and on the 12th, 13th and 14th moved slowly southeastward over the eastern half of the United States as an extensive area. On the two latter days it produced the minimum temperatures of the month in the Ohio valley and Atlantic States.

No. VIII appeared over the Northwest during the 14th in rear of low No. VIII and during the 15th moved eastward to the Atlantic States, where it remained until the 17th, when it disappeared to the eastward.

No. IX.—The pressure, which had continued comparatively high on the Pacific coast since the passage of high No. VI, rose decidedly during the 14th over Oregon, and continued high over this region until the 16th, when this area was transferred to the Plateau Districts, but with diminishing pressure. During the 17th it was apparently transferred to the Southwest and on the 18th covered the Gulf States.

No. X appeared over Manitoba on the night of the 18th, and during the 19th extended eastward over Canada, as low area No. XI began its eastward movement. On the 20th it was apparently to the northward of the St. Lawrence valley.

No. XI slowly developed over the Mississippi valley during the 23rd as low area No. XII moved over Canada and Maine. 24th, it covered the country east of the Mississippi, and on the 25th was transferred to the Atlantic States. 26th and 27th, it moved northeastward over New England and Nova Scotia.

No. XII appeared over Manitoba on the 27th, while low areas Nos. XVII and XVI covered, respectively, the Plateau districts and Mississippi valley. 28th, it extended south and eastward in rear of low area No. XVI and on the 29th moved eastward to the Atlantic States, where it remained until the evening of the 30th, when it gave way in advance of low area No. XVII.

No. XIII appeared over Oregon and Washington Ty. on the 29th, as low area No. XVII moved eastward over the Rocky Mountains; increasing in pressure, but extending southeastward to the Mississippi valley, it, however, remained central on the Pacific coast to the end of the month. Cautionary Off-shore Signals ordered, for a "norther" on the coast of Texas were justified by Indianola, N-42, and Galveston, N. 26.

Areas of Low Barometer.—During the month eighteen areas of low barometer appeared within the limits of observation, nine of which Nos. II, III, IV, V, VI, VIII, IX, XI, XIV, first appeared on the Pacific coast. Four Nos. VII, X, XVI and XVII, were formed, as secondary areas in the depressions left by areas, Nos. VI, IX and XIV. Three, Nos. XII, XIII and XVIII first appeared over, or to the north of Montana, while one No. XV first appeared over the eastern portion of the Gulf of Mexico.

No. I is a continuation of low area No. XX of the *December Review*; its centre passed eastward to the south of Nova Scotia early on the morning of the 18th, accompanied by northerly winds and heavy snow along the coast of Nova Scotia and Cape Breton.

No. II is a continuation of No. XXI *December Review* and was central at 7 a. m., (Washington mean time,) of the 18th to the north of Montana, in which territory brisk to high south to west winds prevailed; during the day it moved rapidly eastward over Canada, accompanied by high westerly winds at the most northerly stations (Pembina, W. 41; Marquette, SW. 34; Escanaba, SW. 32; Saugeen, SW. 33;) light rain fell in the Ohio valley and Lower Lake region. 2d, it passed eastward with its centre to the north of the valley and Gulf of St. Lawrence; at Father Point the wind reached a velocity of NW. 43, at 11 p. m.; light rain fell at Chatham and Sydney. Cautionary Signals ordered on the morning of the 1st at Milwaukee and Grand Haven, at midnight of the 1st from Cape May to Sandy Hook, on the morning of the 2nd from New York to Eastport were justified, except at Eastport, Maine, by the following velocities:—Milwaukee, S. 28; Cape May, SW. 29; Newport, SW. 28; Thatcher's Island, SW. 36. They were ordered late for the New England coast.

No. III appeared on the Pacific coast during the 2nd. At New Westminster, B. C., from 1 to 5 a. m. (local time) a heavy SE. gale prevailed with fierce gusts of wind and rain; wind continued from the SW. throughout the day, at 8 p. m. snow squalls began, and by 9 a. m. of the 3rd the ground was covered with frozen snow to a depth of 1½ inch. Fresh southerly winds and rain throughout the day at Olympia and Portland, O., and occasional light rains thence southward to San Francisco. At night the winds increased to brisk, with light snow at stations in northern Idaho and western Montana. 3rd, moved rapidly eastward over British America, apparently unattended by precipitation near its centre, but preceded in the Upper Mississippi valley and Lake region by foggy and rainy weather, and in Ontario by sleet and snow. 4th, it moved northeastward to Labrador and was followed over the Northwest and Lake region by high area No. III. Cautionary Signals, ordered on the morning of the 3rd at Milwaukee and Grand Haven, and at noon of the 3rd from Cape May to Sandy Hook, were not justified.

No. IV appeared on the Pacific coast on the 3rd, with its centre, like that of the preceding area, to the north of our stations. At New Westminster the barometer at 9 and 11:56 a. m., read 29.75 and 29.76, respectively, after which it fell and at 9 p. m., read 29.60 with heavy rain. "At 11 p. m., a tremendous heavy gale set in from SE., with heavy rain and fierce gusts, which continued, with intervals of dead calm, until 8 a. m. of the 4th. The average velocity of the wind was over 35 miles an hour, but as there were calms and lulls it is estimated that some of the gusts attained a velocity of 60 miles." The observer also states "that there is no doubt this is the heaviest gale we have had here for four years * * the rain came down in sheets * * in fact it was more like a November gale in England than any I have seen since I came here, (1863.)" The rain continued until 8 a. m. of the 4th, at which hour, however, only 0.98 in. was measured, and was followed by flurries of snow; the pressure remained low, the barometer reading 29.42 and 29.43 at 4 and 12 a. m., respectively, after which it rose and by noon of the 5th had regained 29.75. Southerly winds and rain prevailed in Washington, Ty. and Oregon, changing to snow at Olympia. During the night of the 4th and morning of the 5th, high southerly winds and gales, with light drifting snow prevailed in western Montana, and during the afternoon of the latter date, the depression passed rapidly eastward over Manitoba, preceded by rising temperature, fog and light rain, in the Upper Lake Region; thunder and lightning was reported at 11 p. m. at Marquette, and heavy rains fell in the Lower Mississippi valley. On the 6th it probably moved northeastwards to Labrador, as high area No. III. passed to the south of Nova Scotia, and high area No. IV advanced to the Lake region. Cautionary Signals were not ordered in advance of this area.

No. V appeared off the Pacific coast during the evening of the 5th; on the morning of the 6th, its centre was probably over the ocean, some distance to the west of Olympia and moving southwards. The winds at Victoria, New Westminster and Olympia, which on the 5th were southerly or easterly, changed on the 6th to NE. and N., with heavy snow. After a temporary rise of pressure, during the morning of the 6th, at Portland and Olympia the barometer fell rapidly, and at 4 a. m. of the 7th had reached the lowest (29.13 or 0.82 inches below the normal) at Olympia. This was probably near the storm-vortex as the air was calm at the station; at Portland and Umatilla, brisk to high SW. winds prevailed; while to the northward NE. winds prevailed, with very heavy snow. At Pt. Townsend the snow was 3 feet deep; Seattle, 4 feet; Victoria 29 inches and in surrounding country 4 feet; Yale, 10 feet and at New Westminster, 2 feet. Hundreds of barns were demolished by the weight of snow and communication much interrupted. 7th and 8th, the storm moved rapidly eastward, pursuing a course about five degrees south of the two preceding areas, and attended by brisk to high winds and occasional light snow. 9th, at 7 a. m., (Washington time,) it was central in the Upper Mississippi valley and during the day passed over Lakes Michigan and Huron as quite a severe storm; at 11 p. m. it was central near Parry Sound. 10th, it moved down the St. Lawrence valley, accompanied by high winds

and at 3 p. m., was central over the Gulf. Cautionary Signals ordered at Milwaukee and Grand Haven and along the Atlantic coast from Hatteras to New York on the morning of the 9th, and from Wood's Holl to Eastport, during the afternoon of the 9th, were justified at the lake stations and along the New England coast. The following maximum velocities were recorded:—Portland, Or., S. 33; Umatilla SW. 38; Boise, SE. 28; Cheyenne, W. 36; Omaha, NW. 39; Milwaukee W. 42; Eastport, NE. 29.

No. VI appeared on the coast of Oregon early on the morning of the 9th. This was the last, and by far the most severe of a series of five storms, (Nos. II, III, IV, V and VI,) which appeared in rapid succession on the Pacific coast, and subsequently moved eastward across the continent, from December 31st to January 11th. It was encountered early on the morning of the 9th, off the coast of Oregon, by Steamers "Oregon" and "Victoria" of the Pacific Mail Steam Ship Company. The following is an extract from the log of the "Oregon." "Left Astoria for San Francisco on the morning of the 8th, barometer 30.00 and falling; midnight, barometer falling rapidly, wind S. strong gale, squally, sea heavy swell; 9th, 4 a. m., SSE strong gale; 6 a. m., off the Umpqua river, SE hurricane, tremendous sea, barometer 28.20, no change to 10 a. m.; when shipped very heavy sea, sweeping away portion of bulwarks—barometer began rising, wind SE; noon, wind veered to SW. light; 2 p. m. to midnight, SW. squalls with rain, sleet and snow; midnight, wind veered to NW." The Steamer "Victoria" which was 45 or 50 miles distant to the northwest of the "Oregon" experienced NW. winds, while the Oregon had SE. winds, the barometer reading the same on both vessels. The *J. G. Wall* lost bulwarks and rails &c., in very heavy southerly gale on the 8th, (probably 9th) while off Umpqua. Schooner *Emma Utter*, was blown on the rocks above Empire City early on the morning of the 9th. At Empire City a heavy southerly gale prevailed, during which buildings were blown down, wharves washed away and several lighters sunk; the gale was the most severe ever experienced at Coos Bay. In Clatsop county, at the mouth of the Cumberland river, the storm, during Thursday night, (Friday morning) was exceedingly severe; the tide rising six inches higher than before noted; "on Friday the wind suddenly changed to west and, as the trees were heavily laden with snow, struck the forest with terrible effect, loss estimated at thousands of dollars." At Westport, Clatsop county, at 2 p. m., of the 9th, "a storm of snow and wind set in and continued for 2 hours with great fury, uprooting trees &c.; in the neighborhood much damage was done to buildings, bridges, &c." In Washington county, a number of barns and houses were blown down and great destruction done to fences and trees—various roads leading from Portland were completely blocked by fallen timber—the damage in northern part of the county is estimated at \$20,000. In the Willamette valley much damage was done to timber, &c.; at Salem, buildings were damaged during "a severe wind and rain storm, which was followed by a heavy fall of snow." During the day it passed rapidly eastward over Oregon, Washington Territory and Idaho to western Montana, doing much damage throughout the Cumberland valley. The lowest barometer readings occurred at Roseburg between 8 and 12 a. m.; Portland, at 1:20 p. m., at which station an observation was made every 15 minutes from 10 a. m. to 4 p. m., the pressure remaining below 29.00 inches from 10 a. m. to 3 p. m.; Olympia, at 2 p. m.; New Westminster, B. C., 3 p. m.; at Umatilla the pressure, at 2 p. m., was falling and the lowest probably occurred about 6 p. m.; Boise City, Idaho and Virginia City, Montana, at 9 p. m. At Roseburg the wind continued throughout from S. and SW., and at 4 p. m. the rain changed to snow. At Portland the wind was SE. fresh, from 3:57 to 11:30 a. m., when it suddenly increased to a velocity of 40 miles and veered to S.; at 11:45 it increased to 45 miles, and at 1:45 p. m., to 50 miles, though it is estimated that there were occasional gusts of 70 miles; the maximum registered velocity was 53 miles per hour from 1:50 p. m. to 2:05 p. m., this being the highest on record at the station and "without a parallel within the recollection of the early settlers of this State"; at 2:45 p. m. it veered to W. and at 5:30 backed to SW. Many buildings were demolished in the city, the total loss being estimated at about sixty thousand dollars—one person was killed; "the trees, on the hills in the vicinity of Portland, fell toward the NW. during the early part of the storm, and to the NE. and E. during the latter part." At Olympia the wind was S. from 3:56 a. m. to 7 a. m., when it backed to NE. with heavy snow. At noon and 2 p. m. it was N., still snowing, but at 7:56 p. m. had backed to SW., with clear weather. At La Centre, Clark county, a school building was crushed by a falling tree and two children killed. At Vancouver the barracks were damaged to the amount of \$2,000. Steamer *Idaho* left Cascade at noon for Portland, but about 1.30 p. m. met the "terrible" storm and had to return; vessels were driven ashore at Casca e and Grate's Point; at Dallas a heavy wind prevailed, but no damage was done. An observer at Goldendale, Kilikitat county, to the east of the Cascade range, says "the storm from the Willamette, Umpqua and Rogue valleys, came over the Cascade Mountains and down upon us with great fury. The snow had disappeared on the evening of the 8th, but on the morning of the 9th came again from the NE. until noon, when it ceased and a warm breeze set in from the S., which continued to 3 p. m., when a SW. gale commenced and lasted until late in the evening." At Umatilla a velocity of 80 miles was registered; during the morning a light wind blew from the E., and at noon backed to SE, after which it increased rapidly and at 2 p. m. was SW. 60 miles; at 8 p. m., it was W. 32; many buildings were blown down. In Columbia county, at Dayton, the wind, which was SE. at noon, commenced to blow from the SW. about 1 p. m., and continued steady until 6 p. m., when it increased to a hurricane, which lasted until 7; at 8 p. m. the barometer began to rise and the wind fell somewhat, but continued to blow with considerable force from the west throughout the night; buildings were damaged, and in the vicinity a house was literally blown to pieces; at Waitsburg, "wind S., buildings were turned over;" at Pomeroy, church blown down, buildings damaged and on the mountains in the vicinity, forest trees were blown down; at Pataha City "the storm of Friday night was the severest

ever known, damaging barns, &c." At Lewistown, Idaho, at 8.20 p. m. the wind attained a velocity of W. 35 miles. At Boise City the wind was SE. from 4.24 a. m. to 2 p. m.; SW. at 8.24 p. m., and W. at 9 p. m. At Virginia City, from the reports at present to hand, the wind continued in the SW. from noon of the 9th to noon of the 10th, after which it veered to W.; at this station it attained a velocity of 25 miles at 4.40 a. m., of the 10th. So far we have considered only the reports from places near the centre of the storm, but reports from British Columbia, California and Nevada show its influence to have extended to these regions. To the north the precipitation occurred as snow, and some very heavy falls are reported. At Victoria, V. I., snow commenced with a NE. wind at 4 p. m. of the 8th and continued to 3 p. m. of the 9th; at 4.17 p. m. the wind had changed to SW. and was blowing with a velocity of 50 miles per hour. At San Juan, this is reported as "the most severe season ever experienced, and on Friday the barometer fell lower than ever before noted, during which day a severe snow storm prevailed on the Sound, with a wind of 40 miles." At New Westminster, B. C., the barometer began to fall at 4 a. m., and continued falling rapidly until 3 p. m., when it reached 28.68 inches—the lowest reading ever recorded at the station; at 2 p. m. the wind, which had been NE. since the 6th, "began to shift to all quarters (light airs); 3.30 p. m., commenced snowing; 4 p. m., heavy gust of wind from the W., blowing the snow from the tops of the trees in clouds—on the hill tops the snow could be seen moving in dense white clouds to the SSE. of us, the clouds appeared to be revolving in a circle from the west to the south of station." The mail steamer from Victoria to New Westminster experienced northerly gales and tremendous snow storm in the Gulf of Georgia on the 9th. In California a shock of earthquake occurred about 5.45 a. m., and reports from Hollister, Gonzales and Santa Cruz will be found under the appropriate heading. Heavy SE. gales prevailed throughout the day, with rain, changing to S. W. in the evening. At Shasta trees were torn up; at Red Bluff the wind attained a velocity of SE. 60 miles about noon, and snow fell to the depth of about 12 inches on the surrounding mountains; at Modesta, in the San Joaquin valley, a SE. hard wind was blowing, and the weather "cold and bleak." A severe storm of snow and wind set in on the Sierra Nevada Range during the day, (9th) and continued all night (9th-10th) with unabated fury, blockading the main line of the Central Pacific R. R.; between Cisco and Emigrant Gap about 1000 feet of snow sheds were swept away by snow slides from the mountain slopes, and at 11 a. m. of the 10th, 800 feet of sheds were blown down between Cisco and Cascade. In northern Nevada the storm was severely felt and did considerable damage in the southern part of Humboldt county; at Winnemucca the wind reached a velocity of SW. 56 during the evening of the 9th. The accompanying table gives in 13 columns: 1st, the stations in Oregon, Washington Territory, British Columbia, Idaho and western Montana; 2nd, height of barometer cistern above sea-level; 3rd and 4th, time and height of highest reading preceding storm; 5th and 6th, time and height of lowest reading during storm; 7th, 8th and 9th, total fall, duration of fall and fall per hour; 10th to 13th, times of commencement of gale and highest velocity, and direction of wind and miles per hour registered during the highest velocity.

	Altitude of barometer cistern above sea level.	BAROMETER REDUCED TO 32°.							GALE.			
		Began falling—		Lowest reading—		Total fall.	Time of fall's.	Fall per hour.	Began—	Highest velocity.		
		Time.	Height.	Time.	Height.					Time.	Direction.	Miles per hour.
	feet.		inches.		inches.	inch.	hours.	inch.				
*Steamer "Oregon".....		8th, a. m.	30.100	9th, 6 a. m. to 10 a. m.	28.21	1.89	24	0.075	8th, midnight.	9th, 6 a. m. to 10 a. m.	SE	Hurricane.
Roseburg.....	537.0	8th, 9 p. m.	29.35	9th, 7:55 and 11:55 a. m.	28.61	0.74	12	0.062		9th, noon.	SW	26
Portland.....	68.5	8th, 9 p. m.	29.73	9th, 1:20 p. m.	28.51	1.21	16½	0.073	9th, 11:30 a. m.	9th, 1:50 p. m. to 2:50 p. m.	S	55†
Olympia.....	36.0	8th, 9 p. m.	29.62	9th, 2 p. m.	28.48	1.14	17	0.067				
N. Westminster.....	33.0	9th, 4 a. m.	29.68	9th, 3 p. m.	28.68	0.90	11	0.082	9th, 4 p. m.	9th, 4 p. m.	W	Heavy gusts.
Umatilla.....	461.0	8th, 9 p. m.	29.49	9th, 3 p. m.	28.46	1.03	17	0.061	9th, 1 p. m.	9th, 6 to 7 pm	SW	31
Boise City.....	2,877.0	8th, 9 p. m.	27.06	9th, 9 p. m.	26.44	0.62	24	0.024		9th, 2 p. m.?	SE	32
Virginia City.....	5,480.0	9th 8:40 a. m.	23.91	9th, 9 p. m.	23.33	0.58	12½	0.046		10th 4:40 a. m.	SW	26

* From Astoria to off the Umpqua. † Gusts of 70 miles.

10th, it moved eastward over Montana and Dakota to Minnesota, attended by high winds and occasional snow, and on the 11th northeastward over the Lake region into Canada as quite a severe storm. Cautionary Signals ordered on the afternoon of the 10th at Milwaukee and Grand Haven, were justified by NW. 39 miles at the former, and S. 30 miles at the latter place. Sandusky reported SW. 36, and Saugeen SE. 44.

No. VII.—As low area No. VI moved northeastward over the Lake region on the 11th, a barometric trough stretched southwestward to Texas, in the southern extremity of which, the present area formed. On the morning of the 12th it was over northern Mississippi; barometer at Vicksburg, 30.16 or 0.06 below normal; during the day the lowest pressure was transferred to Virginia, and during the evening passed off the coast as high area No. VII advanced from the Northwest; northerly winds, with heavy rain or snow, prevailed throughout the day from Arkansas to Tennessee and the Ohio valley, and extended, by evening,

to the Middle States and New England. 13th, passed to the south of Nova Scotia, and at 11 p. m. was near Cape Breton; rain on the North Carolina coast, and snow thence to Maine, was followed by clearing and clear weather; heavy snow fell in Nova Scotia and Cape Breton. Cautionary Signals ordered from Cape Hatteras to Cape Henry on the afternoon of the 12th, and the morning of the 13th from Wood's Holl to Eastport, were fully justified by the following velocities:—Hatteras, NE. 40; Kittyhawk, NE. 60; Henry, NW. 60; Wood's Holl, NE. 28; Thatcher's Island, NE. 61, and Eastport, NE. 29.

No. VIII appeared on coast of British Columbia during the evening of the 12th; a SE. wind with heavy snow and rain, prevailing at Victoria, V. I. At New Westminster, B. C., snow began to fall early in the morning and continued until 4 p. m., when there were 12½ inches on the ground; it then commenced to rain, and continued throughout the night, with strong SE. wind, in gusts; at 9 p. m. the barometer had fallen to 29.36; rain or snow prevailed in Washington Territory and Oregon, and by 9 p. m. southerly winds (increasing to a gale at Fort Shaw) and light snow were reported from western Montana. 13th, in the morning, "the weather was bright and clear from the west at New Westminster, B. C., after 3 inches more snow during the night." During the day the area moved rapidly eastward to Manitoba; gales prevailed from Wyoming (Fort Fetterman, W. 40 to 59 miles; Cheyenne, W. 42) to Iowa and Minnesota (St. Paul, SE. 52., much damage to buildings); the only precipitation reported was very light rain or snow near the headwaters of the Missouri, at 4 a. m., and light snow (immeasurable) at Escanaba at 11 p. m. 14th, passed into Canada; light snow fell at Parry Sound. Cautionary Signals ordered, at 11 p. m., for Milwaukee and Grand Haven, were justified:—Milwaukee, SW. 26.

No. IX.—At 9 p. m. of the 13th, it commenced snowing at New Westminster, and at 3 a. m. of the 14th, a hard rain set in; at night a heavy SE. gale set in, with hard rain, and at 9 p. m. the pressure had fallen to 29.69. 15th, the wind veered to SSW., heavy rain, followed by clear weather and rising barometer. At 4 a. m. the centre of the present low area was north of Montana, in which State the wind was SW. brisk to high; at 3 p. m. it was central in the Red river of the North valley, with light snow, and at 11 p. m. had moved to the north of Lake Superior. The path of centre, being too far north, is not shown on Chart No. I.

No. X followed rapidly in rear of the preceding area, unattended by precipitation, and at 11 p. m. was central over Wisconsin, by which time, however, light rain or snow had commenced at Escanaba and Marquette. 17th, moved eastward over Ontario, and light rains or snows fell in the Lake region, St. Lawrence and Ohio valleys and Tennessee, and by night rains in the interior of the East Gulf and South Atlantic States. 18th, passed off the Atlantic coast, with light rains along the coast.

No. XI.—At New Westminster, B. C., 16th, "heavy rain, wind from all quarters, followed by warm fresh breeze, from S., river open;" at night SE. gale in gusts;" falling barometer, reaching 29.68 at 9 p. m. 17th, at 4 a. m. storm and gale in western Montana; area moved rapidly eastward during the day to Manitoba, unattended, so far as our reports show, by precipitation, except light snow at Fort Garry and Duluth. 18th, moved southward to Iowa, with clear weather from the centre southeastward and partly cloudy weather on the north and west sides of depression. 19th, remained almost stationary during the morning, with decreasing pressure, in the Lower Missouri valley; in the meantime the surrounding barometric gradient increased, and a strong northeasterly current set in from the Upper Lake region towards Missouri, having, at 3 p. m., an average temperature of 40°; (Milwaukee, 37°; La Crosse, 42°; and Davenport, 40°,) while the opposing southerly winds had a temperature of 52° at Springfield and 66° at Cairo, Ill.; at this hour rain was falling from St. Louis and Indianapolis on the south side to Chicago and Davenport on the north; by 11 p. m. the area had moved eastward and was central between St. Louis and Indianapolis; rain having extended eastward to western Pennsylvania. 20th and 21st, it moved eastnortheastward and at 3 p. m. of latter date was central over Nova Scotia. It was accompanied by heavy snow in the Lower Lake region, northern New York and New England and increasing in energy as it moved eastward, developed into quite a severe storm as it approached the coast of New England. South of the centre of path, as shown on chart I, warm southwest-erly winds and clear or fair weather continued, except a light thunderstorm in the Middle States, the maximum temperatures of the month (68°) occurring at Lynchburg and Fort Whipple, Va. During the night of the 20th and early morning of the 21st it was central between Capes Cod and Sable as a very severe storm. Cautionary Signals ordered at Milwaukee and Grand Haven on the afternoon and along the Atlantic coast from Macon, N. C. to New York at midnight of the 19th, and thence to Eastport at midnight of the 20th, were justified, though late, for the coast of Maine. The following maximum velocities were registered: Milwaukee, NE., 26; Hatteras, SW., 36; Cape May, W., 37; Sandy Hook, NW., 42; Newport, W., 30; Thatcher's Island, E., 32; Portland, NE., 29, and Eastport, NE., 50.

No. XII appeared to the north of Montana on the 20th; gales were reported in western part of state, and light snow fell at Virginia City, Fort Buford and Pembina; during the night the depression was transferred rapidly southward to the Lower Missouri valley, with very light rain at Yankton and La Crosse. 21st, at 3 p. m. warm southerly winds prevailed, with light rains from the East Gulf States to southern Wisconsin and light snow northwards, while to the west of the Mississippi the wind had generally changed to NW.; during the evening a somewhat heavy thunderstorm moved from the central Mississippi valley over Kentucky and Tennessee. 22nd, moved northeastward to Ontario, with light rain turning to snow in the Lake region; light thunderstorms in the South Atlantic States, and rain or snow in the Middle States and

New England. 23rd, moved northeastward, followed by clear weather in New England. Cautionary Signals ordered on the afternoon at Milwaukee and Grand Haven, and at midnight of the 21st along the Atlantic coast from Macon to Sandy Hook; and on the morning and afternoon of the 22nd, thence to Eastport, were justified except at Macon and Lookout. Maximum velocities:—Milwaukee, NW. 30; Grand Haven, SE. 28; Cape Henry, NW. 32; Cape May, NW. E. 40; Sandy Hook, 36; Thatcher's Island, SE. 30, and Eastport, SE. 36. As the pressure increased during the morning of the 22nd over the Southwest, a severe "norther" set in on the coast of Texas, for which Cautionary Off-shore Signals had been ordered on the afternoon of the 21st. They were justified by Indianola, N. 40, and Galveston, N. 32.

No. XIII was to the north of Montana on the afternoon of the 22nd. Its track was too far north to appear on the Chart.

No. XIV appeared on the Pacific coast on the 24th, but reports north of Portland, Oregon, are not yet at hand. At that station, after four days of comparatively high pressure, the barometer fell and by noon reached 29.68, or 0.35 below the normal, wind S.; during the evening and night the barometer rose and the wind veered to NW., and at 9 p. m. the pressure was lowest at Boise (29.81, or 0.38 below the normal.) At this time the wind had increased to a gale in western Montana, and easterly winds, with threatening weather were prevailing at Humboldt and Battleford, British America. 25th, lowest pressures from Montana to Manitoba; the barometer at Virginia City rising from 29.10, or 0.57 below normal, to 29.37, or 0.29 below normal, and falling at Pembina from 29.52, or 0.56 below, to 29.23, or 0.83 below; light snows or rains fell along the Pacific coast, over the western Plateau and at Virginia City, Fort Custer, Deadwood, and Bismarck. The pressure remained low over the Plateau Districts, and the low area arising therefrom will be described as area No. XVII. 26th moved to the northward of Lake Superior. Cautionary Signals were ordered at Milwaukee and Grand Haven, and justified by S. 28 and S. 26 respectively.

No. XV appeared over the eastern Gulf on the 25th, and moved slowly northward during the day. 26th, moved northeastward over Florida, preceded by NE. winds and rainy weather in the East Gulf and South Atlantic States. 27th, moved slowly northeast off the South Atlantic coast. 28th disappeared or merged into the area of low pressure over the Lake region (No. XVI.) Cautionary Signals ordered on the 25th on the North-Carolina coast; along the Gulf and Atlantic coasts from Port Eads to Wilmington on the morning of the 26th, and from Cape May to New York at midnight, were generally justified by winds attending either this area or area No. XVI; maximum velocities, Cedar Keys, S. 25; Savannah, NE. 32; Macon, NE. 35; Lookout, NE. 39.

No. XVI developed in the Southwest during the 26th as low area No. XIV moved into Canada. 27th moved rapidly northeastward to the Lake region unattended by precipitation or high winds. 28th passed rapidly to the Gulf of St. Lawrence.

No. XVII is the secondary depression that was left by area No. XIV over the Plateau Districts and remained there until the 28th. From the 26th to the 28th, stormy weather, with heavy snows, prevailed in California and the Southern Plateau district, of which interesting particulars will be found under the head of "snow." On the 29th it moved eastward in rear of high area No. XII, and preceded by easterly winds, rain or snow to the Lake region. 30th, moved over the Lake region with increasing energy, and on the 31st reached the Gulf of St. Lawrence. Cautionary Signals ordered up on the afternoon of the 29th at Milwaukee and Grand Haven, and along the Atlantic coast from Macon to Sandy Hook, and on the morning of the 30th thence to Eastport were justified. Maximum velocities: Milwaukee, W. 43; Lookout, NE. 39; Cape May, S. 36; Sandy Hook, SW. 48; Boston, W. 45, and Eastport, E. 32. At Boston the anemometer cups were blown away and the wind estimated at 60 miles.

No. XVIII passed eastward from Montana to Lake Superior on the 31st, accompanied by light snow.

INTERNATIONAL METEOROLOGY.

Three International Charts, Nos. IV, V and VI, accompany the present Review. No. IV indicates the probable course of the principal areas of low pressure over the North Atlantic ocean and neighboring waters and continents during the month of *December*, 1879; it is based upon observations made on board about 180 vessels, and which have been collected from various sources or received directly at this office up to February 5th, 1880. Nos. V and VI are charts for the month of *June*, 1878, and are based upon the International Simultaneous Observations, as described in the *Review* for July, 1879, supplemented by such other observations as have been considered specially applicable and trustworthy.

On chart No. IV the tracks of eight of the most prominent areas of low pressure, which, during a portion of their existence, were located over the North Atlantic ocean, are traced. In the following resume only that part of the ocean lying between the parallels of 35° and 55° will be referred to unless specially noted. The month opened with areas of low pressure over Europe, near the Azores, and to the north of Newfoundland. The first has already been noticed, as area No. XIV, chart IV, in the *December Review*; the second is a continuation of area No. XV, chart IV, of the same Review, while the third was probably a continuation of low area No. XVIII of the *November Review*. An extensive area of high pressure (over 30.40 inches or 772.1 m. m.) covered the ocean from 20° to 40° W and north of 45° N. The low area near the Azores, from which islands reports are not yet received, was probably central about 34° N 28° W, moving eastward. Steamer *Borussia* sailed from Coruna on November 26th, and had SE. winds which freshened to